

ABSTRACT

Title: Solar Cell Angle of Incidence Corrections
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Literature on solar array angle of incidence corrections was found to be sparse and contained no tabular data for support. This lack along with recent data on 27 GaAs/Ge 4cm by 4cm cells initiated the analysis presented in this paper. The literature cites seven possible contributors to angle of incidence effects: cosine, optical front surface, edge, shadowing, Wdegradation, particulate soiling, and background color. Only the first three are covered in this paper due to lack of sufficient data.

The cosine correction is commonly used but is not sufficient when the incident angle is large.

Fresnel reflection calculations require knowledge of the index of refraction of the coverglass front surface. The absolute index of refraction for the coverglass front surface was not known nor was it measured due to lack of funds. However, a value for the index of refraction was obtained by examining how the prediction errors varied with different assumed indices and selecting the best fit to the set of measured values. Corrections using front surface Fresnel reflection along with the cosine correction give very good predictive results when compared to measured data, except there is a definite trend away from predicted values at the larger incident angles. This trend could be related to edge effects and is illustrated by a use of a box plot of the errors and by plotting the deviation of the mean against incidence angle. The trend is for larger deviations at larger incidence angles and there may be a fourth order effect involved in the trend. A chi-squared test was used to determine if the measurement errors were normally distributed. At 10 degrees the chi-squared test failed, probably due , to the very small numbers involved or a bias from the measurement procedure. All other angles showed a good fit to the normal distribution with increasing goodness-of-fit as the angles increased which reinforces the very small numbers hypothesis.

The contributed data only went to 65 degrees from normal which prevented any firm conclusions about extreme angle effects although a trend in the right direction was seen. Measurement errors were estimated and found to be consistent with the conclusions that were drawn.

A controlled experiment using coverglasses and cells from the same lots and extending to larger incidence angles would probably lead to further insight into the subject area.